A MARINE AQUARIUM FOR INLAND STUDENTS

A COMMITTEE of the British Association was last year appointed to make some inquiries into the best mode of preserving delicate marine organisms during life, the question being whether the injection of a fine stream of air into the tank in which they are living would be as efficient as, or better for this purpose than, a jet of running water. Dr. Hubrecht, of the Hague, has furnished Mr. Ray Lankester with the following account of a contrivance worked with great success by Prof. Selenka, who has recently given up his chair at Leyden, on account of malaria, and taken a similar post at Erlangen.

A point of the greatest importance for those who study marine animals and who want to keep them alive for a certain time, is the way to keep a limited supply of sea-water fresh and in good condition so as to sustain life in the objects of their researches. Even in those vast institutions on the coast at Brighton, Naples, &c., where the inhabitants of the ocean exhibit their splendours to the eyes of the public, and where there would seem to be no difficulty at all in changing and refreshing the sea-water at any given moment, this point requires more attention and care than is ordinarily supposed, and the success of an aquarium often depends upon the more or less ingenious method by which the refreshing of the water is brought about. Especially important is a free access of atmospheric air, which must enter into solution and sustain the respiration of the different inmates.

To attain this end on a small scale in a laboratory situated at a distance from the sea-coast, with glass vessels of various sizes instead of tanks, and a small barrel of sea-water, which must suffice for a considerable time, the following system, adopted by Prof. Selenka, first in Leyden and at present in Erlangen, gives the most satisfactory results.

A receptacle for fresh water of about 2 cubic ft. or larger is placed in some spare corner, two stories higher than the room in which the aquarium is situated. By means of a siphon reaching to the bottom, the water can be put into communication with a tube leading to the lower floor. A tap enables one to regulate the quantity of water flowing through the siphon. Immediately behind the bend of this and fastened to the side of the receptacle, a so-called Bunsen's aspirator effects the distribution of air-bubbles in the water streaming down. This instrument simply consists of a tube in glass or gutta percha, with an opening as large as a pin's head. The water now continues its way downward through a series of glass tubes of no great width, fastened to nails in the walls by strings.

This system of tubes, to be had at a very small cost and labour, leads the water into a second receptacle in the same room with the improvised aquaria. It consists of a cylinder in zinc of about three feet by one in diameter placed upon a wooden stool; a large tap at the bottom permits its being emptied into a pail. In the lid three small tubes form a communication with the exterior, each of them, as well as the whole apparatus, being closed by taps as hermetically as possible. One of these is put into communication with the above system of tubes which descend to the bottom of the receptacle. The second, to which no interior tube is fastened, is in communication with a pair of bellows which permit the creation of an initial atmospheric pressure in the reservoir. Instead of the bellows a simple tube, half india-rubber, half glass, may do as well, the pressure then being obtained by simple blowing with the mouth. The function of the above apparatus is clearly that of compressing the atmospheric air in the zinc receptacle by means of water descending from a certain height. This compressed air is now used for the refreshing and providing with oxygen of the sea-water in the different smaller vessels.

A third tap in the lid of the zinc reservoir permits the air to escape into a glass bell, where a small mercury manometer indicates the amount of pressure, a detail which may, however, be omitted. In the perforated stop of this bottle from six to twelve hermetically sealed glass tubes—shellac is best for sealing them, india-rubber for the stop itself—are ready to provide the different vessels with a supply of air. With this view india-rubber tubes, which can be shut up by glass staves, form the continuation of the glass ones. When made ready for use, a spring screw applied to this india-rubber tube, regulates the quantity of air flowing out, while a special end-piece conducting the air-bubbles into the vessel with sea-water is pushed into the open end of the tube.

Those end pieces form an important part of the apparatus and may give rise to a great economy of the force required, when by some well-adapted combination their effect is multiplied.

In order to obtain the greatest advantage from the air-bubble which, when the apparatus is put into working order, rises through the sea-water in the vessel into which one of the tubes is brought, it is desirable that it should present as large a surface as possible to the water; making the contact more perfect and the dissolving process easier.

A so-called vulcanised rose, with numerous fine pores, is for this purpose fixed to the extremity of the tube on the bottom of the vessel. This may be replaced by a simple india-rubber stop which has been applied to the extremity of the tube, and into which extremely fine glass tubes—easily got by pulling out a thicker one before the blowpipe and cutting it to the required lengths—have been inserted. Or we may take two flat circular pieces of vulcanised india-rubber connected together, and fix into the border of the lower one a series of such fine glass tubes disposed like the spikes of a wheel, care being at the same time taken that the communication be maintained between the hollow part of this india-rubber disc to which the hair tubes correspond and the glass tube providing the air.

To make the effect in the water still more complete, a small water wheel (the paddles of which are made of thin half-spheres of glass, the axis of a vulcanised tube revolving round a glass stave) may be placed above the rising stream of air-bubbles, which put the wheel in a slow rotation, and cause in this way a constant movement of the particles in the sea-water, a circumstance which cannot but be favourable.

Nearly the whole of the apparatus described above may be made at home, and can be had at very little cost. It is of great efficiency and keeps the sea-water in the

smaller vessels in a wonderful condition of purity, if care be taken to remove dying specimens and if no feeding be going on. Development of eggs and larvæ may be studied without the necessity of changing the sea-water excepting at considerable intervals of time, and marine animals of the most varied types can be kept alive very long indeed at a very small expenditure.

If put into practice by any private zoologist or laboratory in Britain, the results will most probably be no less gratifying than they have been in the above-named places where the system has only as yet been carried out.

A little more costly but still more efficient is a zinc gasometer, which can contain about half a million cubic centimetres of air, with a diameter of about 60 centims. This may be placed as it is in Erlangen without difficulty in the corner of any laboratory. It is wound up every morning by means of a simple capstan, and the pressure is effected by stones put on the top. The quantity of air escaping can be accurately regulated by hermetic taps in the conducting tube.

The great advantage which it has in common with the apparatus described above is that it remains active without further interference for a space of twenty-four hours.

FOSTER'S "PHYSIOLOGY"

Physiology. (Science Primers). By M. Foster, M.A., M.D., F.R.S. (Macmillan and Co., 1874.)

IT is extremely seldom that a fairly informed reader can lay down any text-book, after having read it from end to end, and feel that it has completely fulfilled the purpose for which it was written. Either the method of explanation is imperfect and involved, the facts that are given being correctly stated, or the language may be excellent at the same time that there is a want of attention to accuracy. We believe, however, that all will agree with us in thinking that in this short "Science Primer" Dr. Michael Foster has succeeded in producing an introductory manual which is perfect in itself, and quite a type for future authors of similar productions.

Many who devote themselves to the higher branches of scientific inquiry seem to have an inborn fear of putting the arguments and facts of their favourite subject in any but the most uninteresting and unintelligible language. They write on the assumption that their readers are all as well informed, or nearly so, as themselves on the literature of the science of which they treat; consequently, to the majority their works are of comparatively little value. This imperfection is manifest in many text-books, the utility of which is thereby reduced below that of many otherwise less worthy productions to the commencing student.

In the work before us, however, we think that Dr. Foster has succeeded, beyond any author with which we are acquainted, in placing himself on a level with his intended readers, and in putting the fuudamental principles of physiology before the commencing student in a language, and by means of a consecutive argument, which possesses quite sufficient intrinsic attraction to tempt anyone with the least predilection in that direction, to study, reason out, and attempt to verify his statements. Dr. Foster's similes are peculiarly to the point, and are at the same time drawn from such well-known sources, that no one will have the least difficulty in perceiving their applicability, at the same time that he will be able to realise the full importance of their bearing. The following is one of the best of these, and will well repay the reading :—

"When you look down upon a great city from a high place, as upon London from St. Paul's, you see stretched below you a network of streets, the meshes of which are filled with blocks of houses. You can watch the crowds of men and carts jostling through the streets, but the work within the houses is hidden from your view. Yet you know that, busy as seems the street, the turmoil and press which you see there are but tokens of the real business which is being carried on in the house. So it is with any piece of the body upon which you look through the microscope. You can watch the red blood jostling through the network of capillary streets. But each mesh bounded by red lines is filled with living flesh, is a block of tiny houses, built of muscle, or of skin, or of brain, as the case may be. You cannot see much going on there, however strong your microscope; yet that is where the chief work goes on. In the city the raw material is carried through the street to the factory, and the manufactured article may be brought out again into the street, but the din of the labour is within the factory gates. In the body the blood within the capillary is a stream of raw material about to be made muscle, or bone, or brain, and of stuff which, having been muscle, or bone, or brain, is no longer of any use, and is on its way to be cast out. The actual making of muscle, or of bone, or of brain, is carried on, and the work of each is done, outside the blood, in the little plots of tissue into which no red corpuscle comes."

Notwithstanding the simplification of the argument to its extreme degree, no attempt is made to arrive at this simplification at the expense of truth. We are not informed, as is often said, that venous blood contains carbonic anhydride dissolved in it, whilst in arterial blood this is replaced by oxygen; but more accurately, though less simply, that "both contain, dissolved in them, oxygen, nitrogen, and carbonic acid; venous blood contains less oxygen and more carbonic acid than arterial blood."

Some will think that many of the straightforward facts of the circulation should not be studied until they can be appreciated, unassisted, in their logical sequence; but we think that the following quotation will give a reality to the peregrinations of a blood-corpuscle which comes home to even very young minds. "Suppose you were a little red corpuscle, all by yourself, in the quite empty blood-vessels of a dead body, squeezed in the narrow pathway of a capillary, say of the biceps muscle of the arm, able to walk about, and anxious to explore the country in which you found yourself. There would be two ways in which you might go. Let us first imagine that you set out in the way which we will call backwards. Squeezing your way along the narrow passage of the capillary in which you had hardly room to move, you would at every few steps pass, on your right hand and on your left, the openings into other capillary channels as small as the one in which you were. Passing by these you would presently find the passage widening, you would have more room to move, and the more openings you